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AI-Driven Hand Gestures for Intuitive Control of the Virtual Mouse

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ABSTRACT

The development of artificial intelligence technology has led to a rise in the usage of hand gesture recognition for virtual device control. This research proposes a hand gesture-controlled virtual mouse system that uses AI algorithms to recognize hand gestures and convert them into mouse movements. For those who have trouble using a typical mouse or keyboard, the system is made to offer an alternate interface. The suggested system takes pictures of the user's hand via a camera, which are then analyzed by an AI algorithm to identify the motions being made. The system is trained using a dataset of hand motions to recognize various movements. Once the gesture has been identified, it is converted into an appropriate mouse movement and then carried out on the virtual screen. The system is intended to be scalable and flexible enough to work with various surroundings and gadgets. With the use of vocal commands and dynamic or static hand gestures, all input activities may virtually be controlled. In our work, hand motions and vocal instructions are recognized using machine learning (ML) and computer vision techniques, all of which operate without the need for extra hardware. CNN and the media pipe framework are used to put the model into practice. Potential uses for this technology include offering an alternate interface for a hardware mouse and enabling hands-free usage of gadgets in dangerous locations. The hand gesture-controlled virtual mouse system overall presents a potential strategy to increase accessibility and user experience through human-computer interaction.

Keywords: Computer vision, hand gesture recognition, Media-pipe, virtual mouse

INTRODUCTION

There are many aspects of daily living that are influenced by technology. There are so many technologies available now, and computer technologies are advancing concurrently over the globe. They are used to carry out a variety of duties that people are incapable of carrying out. They actually control human life since they are capable of performing things that humans are incapable of. A mouse or other output device can be used for human-computer interaction. The mouse is a tool for interacting with a GUI and is used for actions like pointing, scrolling, and moving, among others. If we carry a hardware mouse with us wherever we go, it will take a long time to complete complicated activities using the hardware mice in PCs and touchpads in laptopswould occasionally be harmed.

To increase functionality and allow for simple, uncomplicated motions, technology has transformed the mouse's wired capabilities into wireless functionality over the years. Speech recognition technology emerged as technology began to advance. Although it can take some time, recognition can eventually accomplish mouse operations. This recognition is mostly utilized for speech recognition for the purpose of voice searches and translation. Later, the eye tracking techniques for computer control and human-computer interface computer mouse pointer. The main disadvantage of this technology is that it could take some time to catch someone's eye movement if they are wearing contact lenses or have lengthy eyelashes.

Artificial intelligence-based hand gesture control of a virtual mouse enables users to operate their computer mouse using hand motions without the usage of a real mouse. This technology tracks the user's hand motions and employs a camera vision-based method to carry out mouse tasks on the computer screen. A camera pointing at the user's hand provides visual input to the system, which then processes it. After that, the computer vision algorithms review the video feed to locate and follow the user's hand. Machine learning models that have been taught to recognize certain hand gestures, such as pointing or swiping, and convert them into equivalent mouse motions are provided this information.

RELATED WORKS

In the past, development on the AI virtual mouse had been done in the gloves that users wore to recognize and gather data from the system. Later, a different approach for gesture identification connected colored pieces of paper to hands. However, these techniques are not particularly practical for precise mouse manipulation. Recognizing the gloves in a glove-based technique is not practical and might be allergic for users with sensitive skin types. Long-term glove use is also challenging. It might perspire, leading to skin rashes and allergic responses. When using colored tips, the optimum outcomes for gesture detection and identification are not always guaranteed.Now, several further contributions have been made that draw on Google's media pipe foundation work. The present gesture-controlled virtual mouse allows us to manipulate the mouse cursor and carry out certain mouse actions like left-clicking, right-clicking, dragging and dropping, adjusting the brightness and volume, etc. With camera-based detection of the hand gesture interface, efforts have been made to recognize hand gestures

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This evaluation examines the design process for a hardware-based system. Even though this model gives highly precise results, wearing a glove that greatly restricts the user's hand's range of motion, speed, and agility makes it difficult to perform many actions. Additionally, prolonged glove use might cause skin conditions and is not recommended for people with sensitive skin.

They developed a machine-user interface for hand gesture identification that employs simple multimedia and computer vision algorithms. However, a key drawback is that before using gesture comparison algorithms, skin pixel identification and hand segmentation from stored frames must be finished.a technique for using a mouse without any electrical components, such as sensors. All you need is a webcam. Additionally, using hand motions, the mouse's functionalities like clicking and dragging files are performed. The proposed model's accuracy performance is poor, and it lacks additional mouse capabilities.

The hand's predicted radius is discovered, and the hand's center is identified in this model. Additionally, fingertip points have been identified using the convex hull method. Every mouse movement is controlled by a hand gesture. The issue with this method is that saving the frame first and then processing it for detection takes longer than is required in real-time.

In this system, the vision-based approach has been tested. used a camera to detect and recognize gestures. Additionally, no extra equipment was used, such as gloves or sensors. employs the YOLOv5 algorithm and artificial intelligence (AI) only to recognize hand movements and enhance HCI.

Using techniques for color variation, the system may produce colorful masks. Later mouse operations are performed using hand motions. Implementing this strategy is challenging.

ALGORITHMS AND TOOLS USED

We are utilizing one of the most efficient open-source libraries, mediapipe, for the aim of detecting hands and fingers. This framework was created by Google and OpenCV to carry out several CV-related activities. For the purpose of identifying hand gestures and following their movements, this program makes use of machine learning-related principles.

A. Mediapipe

For the purpose of enabling the creation of cross-platform, real-time computer vision applications, Google established the open-source MediaPipe framework. It provides a variety of pre-made tools and components, including object identification, position estimation, hand tracking, facial recognition, and more, for processing and analyzing video and audio streams.
Using MediaPipe, developers can create complex pipelines that include a number of algorithms and processes and run in real-time on a range of hardware platforms, including CPUs, GPUs, and specialized accelerators like Google's Edge TPU. Additionally, the framework supports numerous programming languages, including C++, Python, and Java, and offers interfaces that make it easier to connect with other popular machine learning libraries, such as TensorFlow and PyTorch.

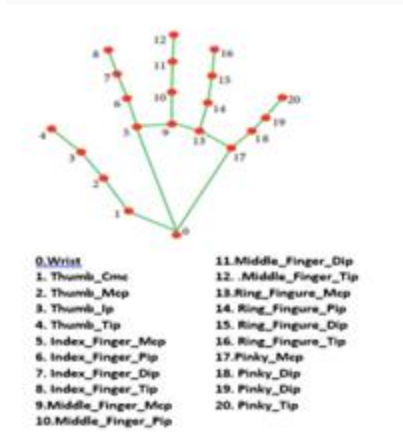

Fig -1: Hand Coordinates or Landmarks

MediaPipe provides tools for training and deploying machine learning models for a range of applications, including object identification, location estimation, facial recognition, and more. Overall, MediaPipe is a powerful toolkit that enables developers to quickly build complex real-time computer vision and machine learning applications.

B. Open CV

A programming function built in C++ that is primarily focused on computer vision is called OpenCVOpen-Source Computer Vision Library. Intel released it under an Apache license. It is free to use and cross-platform to utilise this library.It offers GPU acceleration characteristics for real-time operation.OpenCV is utilized in many different fields, including as mobile robots, facial and gesture recognition systems, and 2D and 3D feature toolkits.

METHODOLOGY

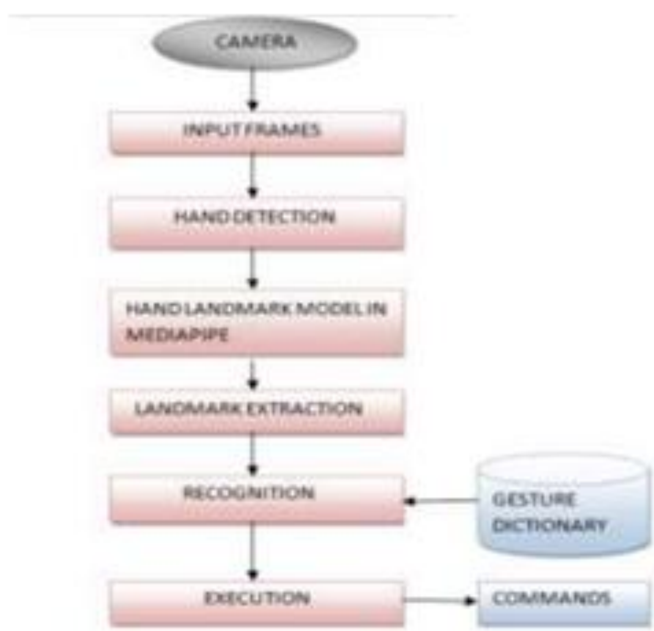

Fig -2: Flow graph of Hand Gesture Recognition

The AI Virtual Mouse System's camera is:

According to the frames, the suggested system employs a web camera to capture photos or video. For capturing, we are utilizing the Python-based Opencv module from the CV. Opencv will start recording the video and build an object for video capture. The frames from the collected web camera are given to the AI-based virtual system.

Processing and Video Capture:

Up to the program's finish, the frame was captured using an AI virtual mouse system. The hands in the frame in each set must then be located using the processed video. The procedure involves converting the BRG pictures into RGB images, which may be done using the code below.

image = cv2.cvtColor(cv2.flip(image, 1), cv2.COLOR_BGR2RGB) results = hands. Process(image) image. flags. Writeable = False

Rectangular zone for Moving Through the Window:

The windows display has a rectangular zone designated for capturing hand gestures and performing mouse actions in response to the gesture. The detection starts to identify the action based on which the mouse pointer functions will be carried out when the hands are discovered under such rectangular areas. The rectangle area is designed with the intention of using the web camera to record hand motions made with the mouse cursor.

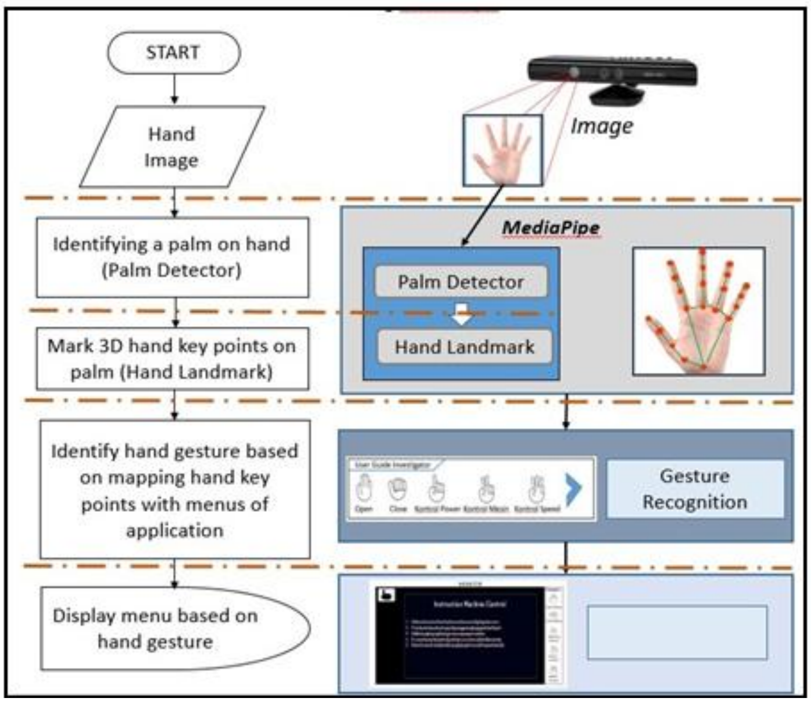

Fig 3. Architecture diagram

RESULTS

People with impairments who might have trouble using a regular mouse or keyboard may find an alternate option in a hand-gesture-operated virtual mouse. They may find it simpler to engage with computers and other gadgets thanks to this technology. For those who prefer to use their hands, a virtual mouse with hand gestures might be handy.

Without being bound to a real mouse touchpad, you may work or play games. With the help of this model, they will be able to operate their gadgets without a physical interface.

A hand gesture-controlled virtual mouse may provide more precision and speed than conventional mice or video editing, depending on the technology being utilized. The user experiences this technology offers will be key to its success. If the technology is user-friendly, dependable, and has an intuitive UI, it will probably be well-liked.

However, if the technology is challenging to use, unreliable, or confusing, consumers may give up on it fast.

Fig 4. Test results

CONCLUSION

A cutting-edge device called an AI virtual mouse that uses hand movements has the potential to completely change how we interact with computers. Here, we have developed a system to control the mouse cursor and perform its purpose using a real-time camera. Without the need of a mouse, it gives users a more comfortable, natural, and accessible way to move the cursor across the screen.

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